LIBRARY OF THE
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

016.7114
C73e
no. 1415-1428

CITY PLANNING AND
LANDSCAPE ARCHITECTURE

016.7114
C73e
Exchange Biblio.
#1415-1428
UNIVERSITY OF ILLINOIS LIBRARY
Name Binding
Identification Number 7.3.78
Address
Jim Rosen
346528937
58 E. John #10
Due 4u... J1-84

116

Council of Planning Librarians Exchange Bibliography

December 1977

1416

MATHEMATICS IN URBAN SCIENCE: V. CATASTROPHE THEORY

Anthony G. White

Mrs. Mary Vance, Editor
Post Office Box 229
Monticello, Illinois 61856

COUNCIL OF PLANNING LIBRARIANS Exchange Bibliography #1416

MATHEMATICS IN URBAN SCIENCE:
V. CATASTROPHE THEORY

By

Anthony G. White

Copyright (C) 1977 Anthony G. White

Several years ago this author generated a series of four bibliographies entitled "Mathematics in Urban Science." They dealt with the practical application of mathematics - equations, numbers, statistics, computer science - to the major urban fields of sociology, political science, technology transfer, economics, and planning. This bibliography is much more esoteric and embryonic.

Catastrophe theory has only been recognized as a separate theory for approximately 10 years. Developed mainly by French mathematicians, it is an outgrowth of cybernetics -- machine/equilibrium studies - and topology, a branch of mathematics about five steps beyond simple geometry.

Basically, mathematicians have realized that many actions and phenomena in nature are characterized by sudden "jumps" in the state of an object or process. Some examples of this are: the breaking of a piece of metal; shock waves; changes in electron orbits about an atomic nucleus; and so on. These "jumps," or singularities, take place when a process or object is in transition from one phase to another.

Mathematicians have blended the elements of mappings, characteristics of singularities, differential equations, and topology to produce a series of seven basic catastrophes, best illustrated graphically in the article by Panati. This theory demonstrates how what appears to be a continuous process can have substantial "jumps" and still be described by equations and continuous curves.

More recently, social scientists have attempted to apply this theory to activities of human groups, i.e., prison riots. This has generated a storm of controversy within the scientific community, wherein the theory's detractors make the point that the theory has not yet even proved itself in the physical world, let alone the sociological one.

If catastrophe theory should prove its worth, then one could expect it to be used in predictive situations election outcomes, outbreaks of crime, decision-making, and so on. This could in turn become a valuable tool for the urban scientist trying to understand - and control - processes that impact on urban areas.

Whether or not catastrophe theory can prove itself, it represents the extension of an ongoing process in the attempt to understand why the world functions as it does. Thus, if as with cybernetics the theory fades into the background, one can be assured that mathematicians - who like the rest of us need to understand the world around us - will continue in the attempt to construct a unified theory to explain natural and human phenomena.

Arnol'd, V. I. "Integrals of Rapidly Oscillating Functions and Singularities of Projections of Lagrangian Manifolds," Functional Analysis Applications, Vol. 6, 1973, pp. 222-224.

_____. "Lectures on Bifurcations in Versal Families," Russian Mathematical Surveys, Vol. 5, 1972, pp. 54-123.

_____. "Normal Forms for Functions near Degenerate Critical Points, the Weyl Groups of A_k, D_k, E_k and Lagrangian Singularities," Functional Analysis Applications, Vol. 6, 1973, pp. 254-272.

Baas, N. A. On the Models of Thom in Biology and Morphogenesis. Charlottesville: University of Virginia, 1972. Lecture notes.

Brocker, Th. and L. Lander. Differentiable Germs and Catastrophes. Cambridge, England: Cambridge University Press, 1975.

Croll, James and Rene Thom. "Is Catastrophe Theory Dangerous?" New Scientist, Vol. 70, June 17, 1976, pp. 630-632.

Deakin, Michael A. B. "Catastrophe Theory," Science, Vol. 196, June 17, 1977, p. 1272.

_____. "Proof of a Catastrophe Theory Theorem," Bulletin of Mathematical Biology. In Press.

Fowler, D. H. "The Riemann-Hugoniot Catastrophe and van der Waals Equation," Towards a Theoretical Biology, Vol. 4, 1972, pp. 1-7.

Gilmore, R. "Structural Stability of the Phase Transition in Dicke-like Models," Journal of Mathematical Physics, Vol. 18, No. 1, January 1977, pp. 17-22.

Godwin, A. N. "Three Dimensional Pictures for Thom's Parabolic Umbilic," Institute Hautes Etudes Science Publications Mathematics, Vol. 40, 1971, pp. 117-138.

Guckenheimer, J. "Bifurcation and Catastrophe," in M. Peixoto, ed., Proceedings of the International Symposium in Dynamical Systems. New York: Academic Press, 1973.

_____. "Catastrophes and Partial Differential Equations," Annals of the Institute Fourier, Vol. 23, 1973, pp. 31-59.

_____. "Review of Thom's 'Stabilite Structurelle et Morphogenese'," Bulletin of the American Mathematical Society, Vol. 79, 1973, pp. 878-890.

_____. "The Cusps of Zeeman's Catastrophe Machine," Topology, Vol. 16, No. 2, 1977, pp. 177-180.

Hatze, H. "A Myocybernetic Control Model of Skeletal Muscle," Biological Cybernetics, Vol. 25, No. 2, 1977, pp. 103-119.

Hilton, P. in D. G. Figueiredo, ed. Functional Analysis. New York: Marcel Dekker, 1976.

Janich, K. "Caustics and Catastrophes," Mathematical Annals, Vol. 209, 1974, pp. 161-180.

Jones, D. D. "Entropic Models in Biology: The Next Scientific Revolution?" Perspectives in Biology and Medicine, Vol. 20, No. 2, Winter 1977, pp. 285-299.

Kallman, Carl-G. "Cusp Catastrophes and Phase Transition in Dense Nuclear Matter and Finite Nuclei," Physica Scripta, Vol. 14, No. 5, November 1976, pp. 147-148.

Kolata, Gina B. "Catastrophe Theory: The Emperor Has No Clothes," Science, Vol. 196, April 15, 1977, pp. 287, 350-351.

Lewis, Marc. "Catastrophe Theory," Science, Vol. 196, June 17, 1977, p. 1270.

Luedtke, P. P. "Catastrophe Model: Can It See Crises?" Science Digest, Vol. 81, February 1977, pp. 68-70.

Marriage, Hugh. "Prison 'Catastrophe'," New Scientist, Vol. 71, July 22, 1976, p. 195.

_____, C. S. Hall and P. H. Shapland. "A Model for Institutional Disturbances," The British Journal of Mathematical and Statistical Psychology, Vol. 29, 1976, p. 66.

McDuffee, F. T., et.al. "Pringle's Fly Wing Machine," American Journal of Physics, Vol. 45, No. 3, March 1977, pp. 303-305.

Panati, Charles. "Catastrophe Theory," Newsweek, January 19, 1976, pp. 54-55.

Pham, F. "Classification des Singularites," Douzieme Reconte entre Mathematiciens et Physiciens. R.C.P. No. 25, 1971.

_____. Remarque sur l'equisingularite universelle. Nice: University of Nice, 1970. Mimeograph.

Porteous, I. R. "The Normal Singularities of a Submanifold," Journal of Differential Geometry, Vol. 5, 1971, pp. 543-564.

Poston, T. and A.E.R. Woodcock. A Geometrical Study of the Elementary Catastrophes. New York: Springer-Verlag, 1974.

_____. "On Zeeman's Catastrophe Machine," Proceedings of the Cambridge Philosophical Society, Vol. 74, 1973, pp. 217-226.

Rosen, Robert. "Catastrophe Theory," Science, Vol. 196, June 17, 1977, pp. 1270-1272.

Rosenhead, Jonathan. "Prison 'Catastrophes'," New Scientist, Vol. 71, July 15, 1976, p. 140.

Senechal, Marjorie. "Catastrophe Theory," Science, Vol. 196, June 17, 1977, p. 1270.

Shulman, L. S. and M. Revzen. "Phase Transitions as Catastrophes," Collective Phenomena, Vol. 1, 1972, pp. 43-47.

Steen, L. A. "Catastrophe Theory: The First Decade," Science News, Vol. 111, April 2, 1977, pp. 287+.

Sussman, Hector J. "Catastrophe Theory," in F. Suppe and P. D. Asquinth, eds., PSA 1976: Proceedings of the 1976 Biennial Meeting of the Philosophy of Science Association. East Lansing: PSA, 1976, Vol. I, pp. 256-286.

_____. "Catastrophe Theory: A Skeptic," Science, Vol. 197, August 26, 1977, pp. 820-821.

_____ and R. S. Zahler. Synthese. In Press.

Symposium on Catastrophe Theory, Seattle 1975. New York: Springer-Verlag, 1977.

Takens, F. "Unfoldings of Certain Singularities of Vector Fields, Generalized Hopf Bifurcations," Journal of Differential Equations, Vol. 14, 1973, pp. 476-493.

Thom, Rene. "A Mathematical Approach to Morphogenesis. Archty pal Morphologies," Wistar Institute Symposium Monograph, No. 9, 1969, pp. 165-174.

_____. "Sur la Typologie des Langues Naturelles: Essai d'identification Psycholinguistique," in A. Merton, ed., Formal Analysis of Natural Languages. Janua Linguarium, 1970.

_____. "Topologie et Linquistique," Essays on Topology and Related Subjects. New York: Springer-Verlag, 1970, pp. 226-248.

_____. Structural Stability and Morphogenesis. New York: W. A. Benjamin, Inc, 1975. (In French, 1972.)

_____. "Topologie et Signification," l'Age de Science, Vol. 4, 1968, pp. 219-242.

_____. "Topological Models in Biology," Towards A Theoretical Biology. Vol. 3, 1971, pp. 89 116.

Trotman, D.J.A. and E. C. Zeeman. "The Classification of Elementary Catastrophes of Codimension 5," in Symposium on Catastrophe Theory, Seattle 1975. New York: Springer-Verlag, 1977.

Vickers, Bob. "Catastrophe," New Scientist, Vol. 71, August 5, 1976, pp. 299-300.

Wasserman, G. "Stability of Unfoldings," Lecture Notes in Mathematics, No. 393. New York: Springer-Verlag, 1974.

Zeeman, E. C. "Catastrophe Theory," Scientific American, Vol. 234, April 1976, pp. 654.

COUNCIL OF PLANNING LIBRARIANS Exchange Bibliography #1416

MATHEMATICS IN URBAN SCIENCE: V. CATASTROPHE THEORY

Additional copies available from:

Council of Planning Librarians
Post Office Box 229
Monticello, Illinois 61856

for $1.50

UNIVERSITY OF ILLINOIS-URBANA
016.7114C73E C001
EXCHANGE BIBLIOGRAPHY. URBANA, ILL
1415-1428 1877
3 0112 029108765